

647. SCIENCE STANDARDS. – GRADES 9 THROUGH 12, SECTIONS 648 THROUGH 658.

The samples associated with the content standards are meant to illustrate meaning and to represent possible areas of application. They are not intended to be an exhaustive list, but are samples of applications that would demonstrate learning.

648. UNIFYING CONCEPTS OF SCIENCE.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand systems, order, and organization.	a. Know the scientific meaning and application of the concepts of system, order, and organization.	i. Analyze, design, assemble, and trouble shoot systems mechanical, electrical, and biological with easily discernable components. ii. Discuss the value of thinking in terms of systems, order, and organization.
02. Understand concepts and processes of evidence, models, and explanation.	a. Know that observations and data are evidence on which to base scientific explanations.	i. Students use a stream table to explore concepts, such as river erosion, and compare the results for the table model to what is known about full-scale erosion models.
	b. Use models to explain how things work.	i. Build and demonstrate a model of the solar system.
	c. Develop scientific explanations based on scientific knowledge, logic, and analysis.	i. Through research explain the value of a recycling program.
03. Understand constancy, change, and measurement.	a. Identify constancy in some concepts in science that do not change with time such as the speed of light.	i. Define a meter in terms of distance traveled by light in a given period of time.
	b. Recognize that change occurs in and among systems and change can be measured.	i. Use demographic data to plot and explain population changes over a period of time.
	c. Measure in both the metric and U.S. customary system.	i. Record Celsius and Fahrenheit temperature readings over a period of time.
04. Understand the theory that evolution is a process that relates to the gradual changes in the universe and of equilibrium as a physical state.	a. Know that the present arises from materials and forms of the past.	i. Diagram the rock cycle. ii. Describe how soil forms.
	b. Understand evolution as a series of changes, some gradual and some sporadic, that account for present form and function of objects, organisms, and natural or mechanical systems.	i. Describe the earth's changes using plate tectonics as an example. ii. Describe the changes in Idaho's vegetation over the last 200 years and explain why they occurred.

	c. Know that equilibrium is a physical state in which forces and changes occur in opposite and offsetting directions.	i. Demonstrate Newton's laws of motion.
05. Understand concepts of form and function.	a. Know that form refers to function and function refers to form.	i. Describe how the foot of a frog and the shape of a leaf demonstrate form and function.

649. CONCEPTS OF SCIENTIFIC INQUIRY.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand scientific inquiry and develop critical thinking skills.	a. Identify questions and concepts that guide scientific investigations.	i. Design, build, and test a bridge for maximum strength. ii. Design an appropriate ecosystem for the front of your school. iii. Identify and solve a community problem or concern using the scientific method.
	b. Design and conduct scientific investigations.	
	c. Use technology and mathematics to improve investigations and communication.	
	d. Formulate and revise scientific explanations and models using logic and evidence.	
	e. Recognize and analyze alternative explanations and models.	
	f. Communicate and defend a scientific argument.	
	g. Know the differences among observations, hypotheses, and theories.	i. Compare Ptolomy's model of the universe to that of Copernicus.

650. CONCEPTS OF PHYSICAL SCIENCE.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the structure of atoms.	a. Know the function and location of protons, neutrons, and electrons.	i. Draw and label a diagram of an atom and list the functions of its components.
	b. Understand the processes of fission and fusion.	i. Compare and contrast the processes of fission and fusion.
	c. Know the characteristics of isotopes.	i. Describe the differences between carbon 12 and carbon 14.

	d. Know the basic electrical properties of matter.	i. Use static electricity to demonstrate attraction and repulsion of charged particles.
02. Understand the structure and function of matter and molecules and their interactions.	a. Know how atoms interact with one another by transferring or sharing electrons.	i. Using the periodic table, determine the atomic number and valence of a given element to predict types of bonding.
	b. Know how bonds between atoms are created when electrons are shared or transferred to form molecules or ionic substances.	i. Compare and contrast ionic and covalent bonds.
	c. Know how the physical properties of compounds reflect the nature of the interactions among its molecules.	i. Describe how molecular structure relates to crystal patterns.
	d. Know how solids, liquids, and gases differ in the energy that bonds them together.	i. Describe the energy level of water molecules as they pass through the three states of matter.
03. Understand chemical reactions.	a. Know that chemical reactions may release or consume energy.	i. Demonstrate exothermic and endothermic chemical reactions.
	b. Know that chemical reactions can occur in time periods that vary from very fast to very slow and that catalysts can affect the rate of a chemical reaction.	i. Demonstrate the change in rate of decay of hydrogenperoxide to water with and without an enzyme.
	c. Identify chemical reactions that are occurring all around us.	i. Identify and describe chemical reactions that occur in the home and community.
04. Understand concepts of motion and forces.	a. Know that gravitational force and electrical force are universal forces.	i. Describe the relationship between mass and weight. ii. Explain the role of electrical forces in the structure of the universe.
	b. Know that objects change their motion only when a net force is applied.	i. Build a CO ² powered car and demonstrate how an applied force affects its motion.
	c. Understand that moving electrical charges produce magnetic forces, and moving magnets produce electrical forces.	i. Build an electric motor and explain how it operates. ii. Explain the generation of electricity in a hydroelectric plant.
05. Understand that the total energy in the universe is constant.	a. Understand that energy can be transferred but it can neither be destroyed nor created.	i. Design and construct devices to transform/transfer energy.

	b. Know that energy can be classified as either potential energy, kinetic energy, or energy contained by a field.	i. Describe the difference between kinetic and potential energy and give examples of each.
	c. Know that heat is evidenced by random motion and the vibrations of atoms, molecules, and ions.	i. Observe the changes in the physical properties of milk as it is heated on a microscope slide.
	d. Know that energy is transferred by various types of waves and by electrons flowing through matter.	i. Explain the basic properties of the electromagnetic spectrum.

651. CELLULAR AND MOLECULAR CONCEPTS.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the cell is the basis of form and function for all living things and how living things carry out their life functions.	a. Know that cells have particular structures that underlie their functions.	i. Explain how the structure and function of a cell are similar to the organizational structure and function of a school.
	b. Know that most cell functions involve chemical reactions.	i. Explain the chemical basis for cell respiration.
	c. Know that cells store and use information in the form of DNA to guide their functions.	i. Describe the similarities and differences between DNA transcription and making multiple copies of student records on an office copy machine.
	d. Know that cell functions are regulated by expressed genes that provide code for the synthesis of proteins.	i. Explain how protein is produced at the cellular level.
	e. Know that cellular differentiation is regulated through the expression of different genes. A single cell can differentiate to form many specialized cells, tissues, and organs.	
02. Understand the form and function of DNA.	a. Know that the instructions for specifying the characteristics of the organism are carried in DNA.	i. Explain what we mean by genetic mapping.
	b. Know that genetic information is both encoded in genes and replicated.	i. Compare the process of mitosis and meiosis.

	c. Know that most of the cells in a human contain 23 pairs of chromosomes, and that transmission of chromosomal information to offspring occurs through the combination of egg and sperm cells.	i. Compare the process of mitosis and meiosis.
	d. Know that changes in DNA (mutations) occur spontaneously at low rates. Some of these changes make no difference to the organism whereas others can change cells and organisms. Only mutations in gametes can create the variation that changes an organism's off-spring.	i. Explain how mutations of an organism's DNA may result in birth defects.
	e. Know that DNA plays a major role in health issues. Through the development of new technologies we have discovered new information about the human genome, medical disorders, and forensic sciences.	i. Find an example of the role of DNA in health issues.

652. INTERDEPENDENCE OF ORGANISMS AND BIOLOGICAL CHANGE.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the theory of biological evolution.	a. Know that the theory of evolution explains how species evolve over time and how evolution is the consequence of interactions of: <ul style="list-style-type: none"> - Potential of a species to increase its numbers; - Genetic variability; - A finite supply of resources; - Selection by the environment of those offspring better able to survive and leave offspring. 	i. Trace the evolution of a species. ii. Explain why some species have changed little over time and others have become extinct.
	b. Know that natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms, as well as for the striking molecular similarities observed among the diverse species of organisms.	

	c. Know that the theory of evolution explains how different species of plants, animals, and microorganisms that live on earth today are related by descent from common ancestors.	i. Identify the ancestors of a present day species.
	d. Know that biological classifications are based on similarities, which reflect their evolutionary relationships.	i. Classify an organism using a dichotomous key.
02. Understand the interdependence of organisms.	a. Know that atoms and molecules cycle among the living and nonliving components of the biosphere.	i. Diagram the nitrogen cycle.
	b. Trace energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.	i. Explain a food chain.
	c. Know that organisms both cooperate and compete in ecosystems.	i. Explain niches in an ecosystem.
	d. Know that living organisms have the capacity to produce populations of infinite size, but environments and resources are finite.	i. List limiting factors of a population in a closed environment.
	e. Know that human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption.	i. Conduct an extended investigation of a local environment affected by human actions.

653. MATTER, ENERGY, AND ORGANIZATION IN LIVING SYSTEMS.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the relationship between matter, energy, and organization to trace matter as it cycles and energy as it flows through living systems and between living systems and the environment.	a. Know that all matter tends toward more disorganized states.	i. Explain entropy.

	b. Know that living systems require a continuous input of energy to maintain their chemical and physical organization.	i. Explain why all organisms need food.
	c. Know that the energy for life is primarily derived from the sun through photosynthesis.	i. Provide evidence that green plants make food and in the significance of this process to other organisms.
	d. Understand cellular respiration and the synthesis of macromolecules.	i. Describe how energy is derived to carry out various functions in organisms.
	e. Know that chemical bonds of food molecules contain energy, which is released when the bonds are broken.	i. Describe the chemical processes of cellular respiration.
	f. Know that cells usually store energy as Adenosine Triphosphate (ATP).	i. Describe the chemical processes of cellular respiration.
	g. Know that the distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy.	i. Describe the relationship between the food supply and the distribution and abundance of a species.
	h. Trace how matter cycles and energy flows through different levels of organization of living systems - cells, organs, organisms, communities - and between living systems and the physical environment.	i. Construct a food web for a community of organisms and explain how elimination of a particular part of a chain affects the rest of the chain and web. Diagram the carbon and oxygen cycles.
02. Understand the individual behavior of organisms and their interactions in populations and communities as influenced by physiological and environmental factors.	a. Know that multi-cellular animals have nervous systems that generate behavior.	i. Demonstrate how an organism responds to various stimuli.
	b. Know that the nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules.	i. Explain the interaction of neurotransmitters and psychoactive drugs.

	c. Know that organisms have behavioral responses to internal changes and to external stimuli., The and that broad patterns of behavior have evolved to ensure reproductive success.	i. Describe the mating behavior of a particular animal species.
	d. Know that behaviors often have an adaptive logic when viewed in terms of natural selection.	i. Record and compare the behaviors of animals in their natural habitats and relate how these behaviors are important to the animals.

654. EARTH AND SPACE SYSTEMS.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand scientific theories of origin and subsequent changes in the universe and earth systems.	a. Know that current scientific theory suggests that the Sun, the Earth, and the rest of the solar system formed from a nebular cloud of dust and gas.	i. Design a poster illustrating the "Big Bang" theory.
	b. Know methods used to estimate geologic time (observing rock sequences and using fossils to correlate the sequences at various locations).	i. Explain why trilobites make excellent index fossils and why they are extremely useful in determining the appropriate age of rocks.
	c. Know that interactions among the solid earth, the oceans, the atmosphere, and organisms have resulted in the ongoing change of the earth system. Some activities are observable (earthquakes and volcanic eruptions) but many take place over hundreds of millions of years.	i. Explain the processes involved in the formation of Hell's Canyon or the Snake River Canyon.
	d. Know that the development of life caused dramatic changes in the composition of the earth's atmosphere.	i. Describe how the earth's atmosphere would be different if life never developed on earth.
	e. Know that the universe is constantly expanding.	i. Explain how the Doppler shift of light from distant galaxies is used by scientists to provide evidence that the universe is expanding.
	f. Know the life history of stars and galaxies.	i. Explain how black holes are formed.

02. Understand geo-chemical cycles and energy in the earth system.	a. Know that earth systems have internal and external sources of energy, both of which create heat. The sun is the major external source of energy.	i. Describe the ways in which solar energy that is not reflected back into space affects the earth (creating heat, causing the water cycle, causing atmospheric and oceanic convection currents, involved in photosynthesis).
	b. Know that the two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from the earth's original formation.	i. Discuss how the decay of radioactive elements drives the convection currents within the earth's mantle according to some theories.
	c. Know that the outward transfer of earth's internal heat drives convection circulation in the mantle that propels the plates comprising the earth's surface across the face of the globe.	i. Describe how the Hawaiian Islands were formed.
	d. Know that the heating of the earth's surface and atmosphere by the sun drive convection within the atmosphere and oceans, producing winds and ocean currents.	i. Explain how solar energy contributes to ocean current patterns.
	e. Know that global climate is determined by energy transfer from the sun at and near the earth's surface.	i. Explain why many scientists are concerned about the greenhouse effect.
	f. Know that the movement of matter through the solid earth, oceans, and atmosphere is driven by the earth's internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of matter.	i. Describe the physical and chemical changes that occur at the different stages of the rock cycle.

655. TECHNOLOGY.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the relationship between science and technology and develop the abilities of technological design and application.	a. Know the ways that science advances technology and technology advances science.	i. Write a paper highlighting how technology has advanced science and how science has advanced technology such as the telescope, microscope, computer chips, etc.

	b. Recognize that science and technology are pursued for different purposes and that scientific inquiry is driven by the desire to understand the natural world and technological design is driven by the need to meet human needs and solve human problems.	i. Compile a case study of a technological development that has had a significant impact on the environment.
	c. Know that critical thinking, creativity, imagination, and a good knowledge base are all required in the work of science and engineering.	i. Identify a natural resource problem or concern and utilize the scientific process to study the problem or concern and identify what technology is available to assist the process.
	d. Know the elements of technological design, which include the following: <ul style="list-style-type: none"> - Identify a problem or design an opportunity; - Propose designs and choose between alternative solutions; - Implement a proposed solution; - Evaluate the solution and its consequences; - Communicate the problem, process, and solution. 	i. Identify a natural resource problem or concern and utilize the scientific process to study the problem or concern and identify what technology is available to assist the process.
	e. Use available technology to assist in solving problems.	i. Use computer models to simulate problems and determine "what if" scenarios. ii. Use current computer software to develop reports and other documents to communicate information.

656. PERSONAL AND SOCIAL PERSPECTIVES.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand common environmental quality issues, both natural and human induced.	a. Identify issues, including but not limited to: <ul style="list-style-type: none"> - Water quality; - Air quality; - Hazardous waste; - Forest health. 	i. Compile a case study of a local environmental issue and describe its impact on Idaho's economy.
02. Understand the causes and effects of population change.	a. Understand the impact of technological development and the growth of human population on the living and nonliving environment.	i. Determine the impact of a changing population on local land use.

	b. Understand the impact of population change on natural resources and community infrastructure.	i. Develop a model of a community that describes the impact on natural resources and community infrastructure as the population changes.
03. Understand the importance of natural resources and the need to manage and conserve them.	a. Understand the differences between renewable and nonrenewable resources.	i. Develop a list of renewable and non-renewable resources.
	b. Understand the differences between preservation and conservation.	i. Investigate the roles of agencies charged with the preservation of natural resources as opposed to conservation and use.
	c. Understand the role and effect of management of natural resources.	i. Examine the role one of our state or federal natural resource agencies and discuss its role in the management of our public lands.
04. Understand different uses of technology in science and how they affect our standard of living.	a. Identify examples of technologies used in scientific fields, including but not limited to: - Weather forecasting; - Food production; - Environmental cleanup; - Advances in medicine; - Communications; - The space program.	i. Identify specific technologies used in a particular scientific field and how they have affected our standards of living.

657. HISTORY OF SCIENCE.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the significance of major scientific milestones.	a. Understand the social and economic impact of historical scientific events.	i. Watch a video about a significant scientific event such as the Apollo 13 mission and interview an adult on their reaction at the time of the event.
	b. Understand the contributions of notable scientists.	i. Read and report about a notable scientist.

658. INTERDISCIPLINARY CONCEPTS.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand that interpersonal relationships are important in scientific endeavors.	a. Know the importance of working in interdisciplinary teams to solve scientific problems.	i. While working in a team, use the information learned in classes such as health, English, math, and social studies to study an environmental issue.
02. Understand technical communication.	a. Read for information.	i. Assemble a model using the instructions supplied from the manufacturer and write a report on suggested revisions to the instructions.

	b. Write and articulate technical information.	i. Assemble a model using the instructions supplied from the manufacturer and write a report on suggested revisions to the instructions.
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